DESCRIBING MOTION

Describing & Measuring Motion

DESCRIBING MOTION

An object is in motion when its distance from another object is changing. Whether an object is moving or not depends on your point of view.

For example, a woman riding on a bus is not moving in relation to the seat she is sitting on, but she is moving in relation to the buildings the bus passes.

REFERENCE POINT

A reference point is a place or object used for comparison to determine if something is in motion. An object is in motion if it changes position relative to a reference point.

fig. 1

fig. 2

You assume that the reference point is stationary, or not moving, such as a sign, tree, or building.

RELATIVE MOTION

Whether or not an object is moving depends on the reference point you choose. Suppose you choose the sun as a reference point instead of your chair.

If you compare yourself to the sun, you are moving quite fast. This is because you are on Earth, which moves around the Sun. So you, and everything on this planet, is moving at about 30 kilometers every second.

Going that fast, you could travel from New York City to Los Angeles in about 2 minutes. Relative to the Sun, both you and your chair are in motion.

MEASURING DISTANCE

Units, or standard quantities of measurement, are used to describe an object's motion.

The system of measurement used by scientists all over the world is called the International System of Units, or in French, Systeme International (SI). The SI system is based on the number 10.

The basic SI unit of length is the meter (m). A meter is a little longer than a yard. To measure the length of an object smaller than a meter, scientists use the metric unit called a centimeter (cm).

Centi means one hundredth, so there are 100 centimeters in a meter. Meters and centimeters can be used to describe the distance an object travels.

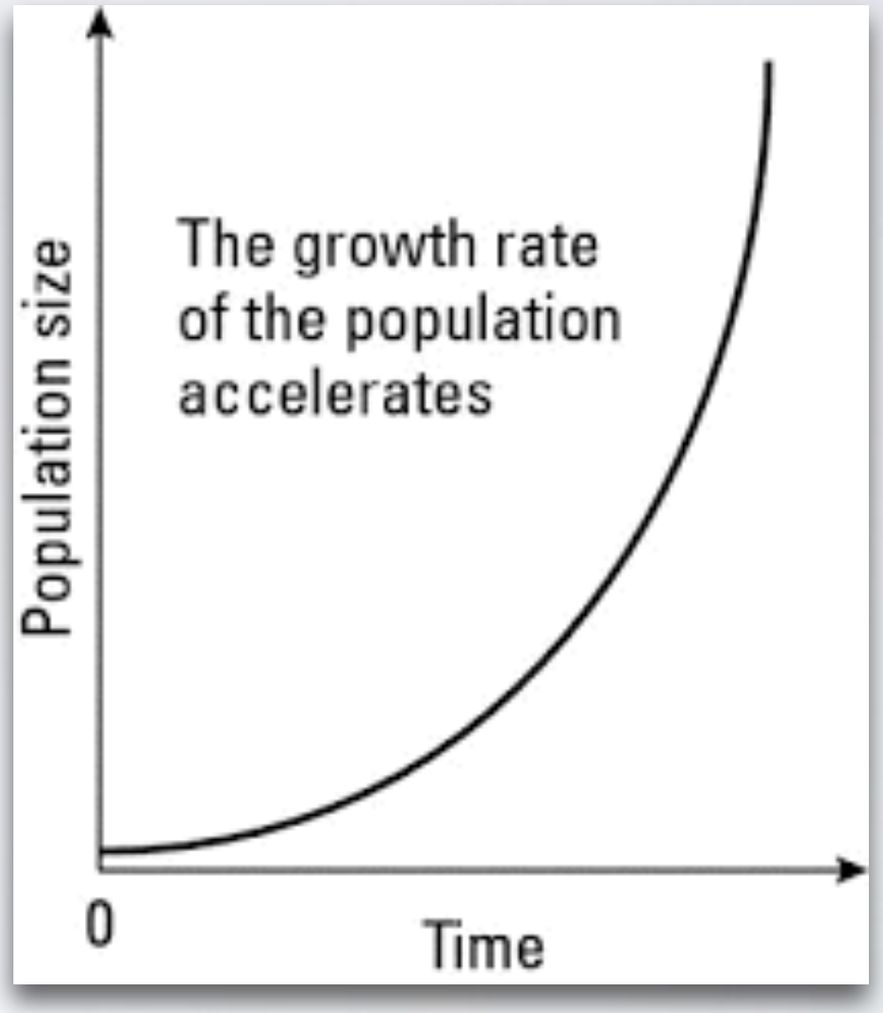
Mass unit	Length unit	Volume unit
megagram, Mg	megameter, Mm	megaliter, ML
kilogram, kg	kilometer, km	kiloliter, kL
hectogram, hg	hectometer, hm	hectoliter, hL
dekagram, dag	dekameter, dam	dekaliter, daL
gram	**meter**	**liter**
decigram, dg	decimeter, dm	deciliter, dL
centigram, cg	centimeter, cm	centiliter, cL
milligram, mg	millimeter, mm	milliliter, mL
microgram, μg	micrometer, μm	microliter, μL

For lengths smaller than a centimeter, the millimeter is used. Milli means one thousandth, so there are 1,000 millimeters in a meter.

Distances too long to be measured in meters are often measured in kilometers. Kilo means one thousand, so there are 1,000 meters in a kilometer.

CALCULATING SPEED

A measurement of distance can tell you how far something traveled. Rate is the amount of something that occurs or changes in one unit of time. Speed is a type of rate.



If you know the distance an object travels in a certain amount of time, you can calculate the speed of the object. The speed of an object is the distance the object travels in one unit of time.

THE SPEED EQUATION

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

To calculate the speed of an object, divide the distance the object travels by the amount of time it takes to travel that distance.

If you measure distance in meters and time in seconds, you express speed in meters per second, or m/s.

AVERAGE SPEED

When an object travels at a constant speed, its speed at any moment during its motion is the same as it is at every other moment. Most objects do not move at constant speeds.

To find the average speed of an object, divide the total distance traveled by the total time.

For example, suppose a cyclist travels 32 kilometers during the first 2 hours. Then the cyclist travels 13 kilometers during the next hour. The average speed of the cyclist is the total distance divided by the total time.

$$\text{Total distance} = 32\text{km} + 13\text{km} = 45\text{km}$$

$$\text{Total time} = 2\text{h} + 1\text{h} = 3\text{ h}$$

$$\text{Average speed} = 45\text{km}/3\text{h} = 15\text{ km/h}$$

INSTANTANEOUS SPEED

An object's instantaneous speed is the rate it is moving at a given instant.

$$\text{Instantaneous Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$800 \text{ km/hr} = \frac{80\text{km}}{0.1\text{hr}}$$

$$\text{Average Speed} = \frac{\text{Total distance}}{\text{Total time}}$$

$$400 \text{ km/hr} = \frac{1200\text{km}}{3\text{hr}}$$

DESCRIBING VELOCITY

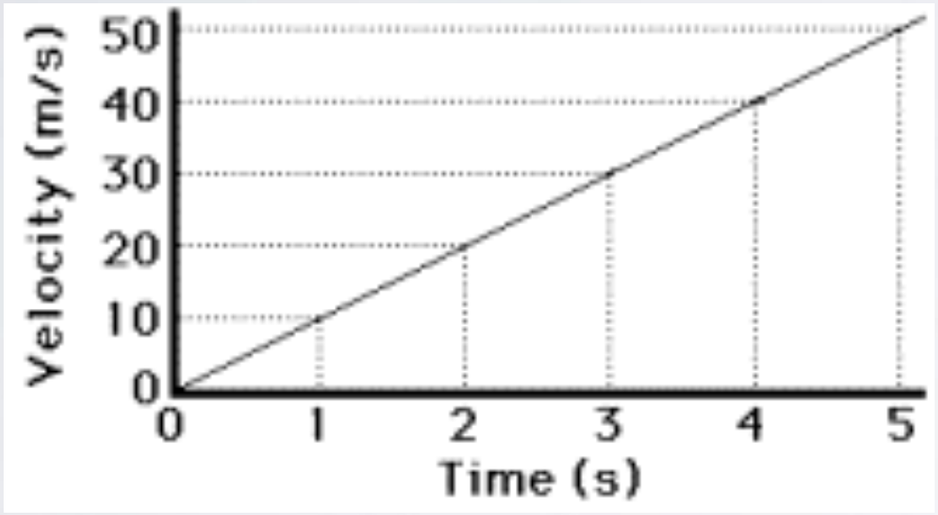
An object's speed tells how fast it is moving, but not the direction of the motion. To describe an object's motion completely, you need to know the direction of its motion.

When you know the speed and direction of an object's motion, you know the velocity of the object. Speed in a given direction is called velocity.

For example, suppose you hear a that a thunderstorm is traveling at a speed of 25 km/h.

To know whether you should prepare for the storm, you need to know the direction in which it is traveling.

GRAPHING MOTION



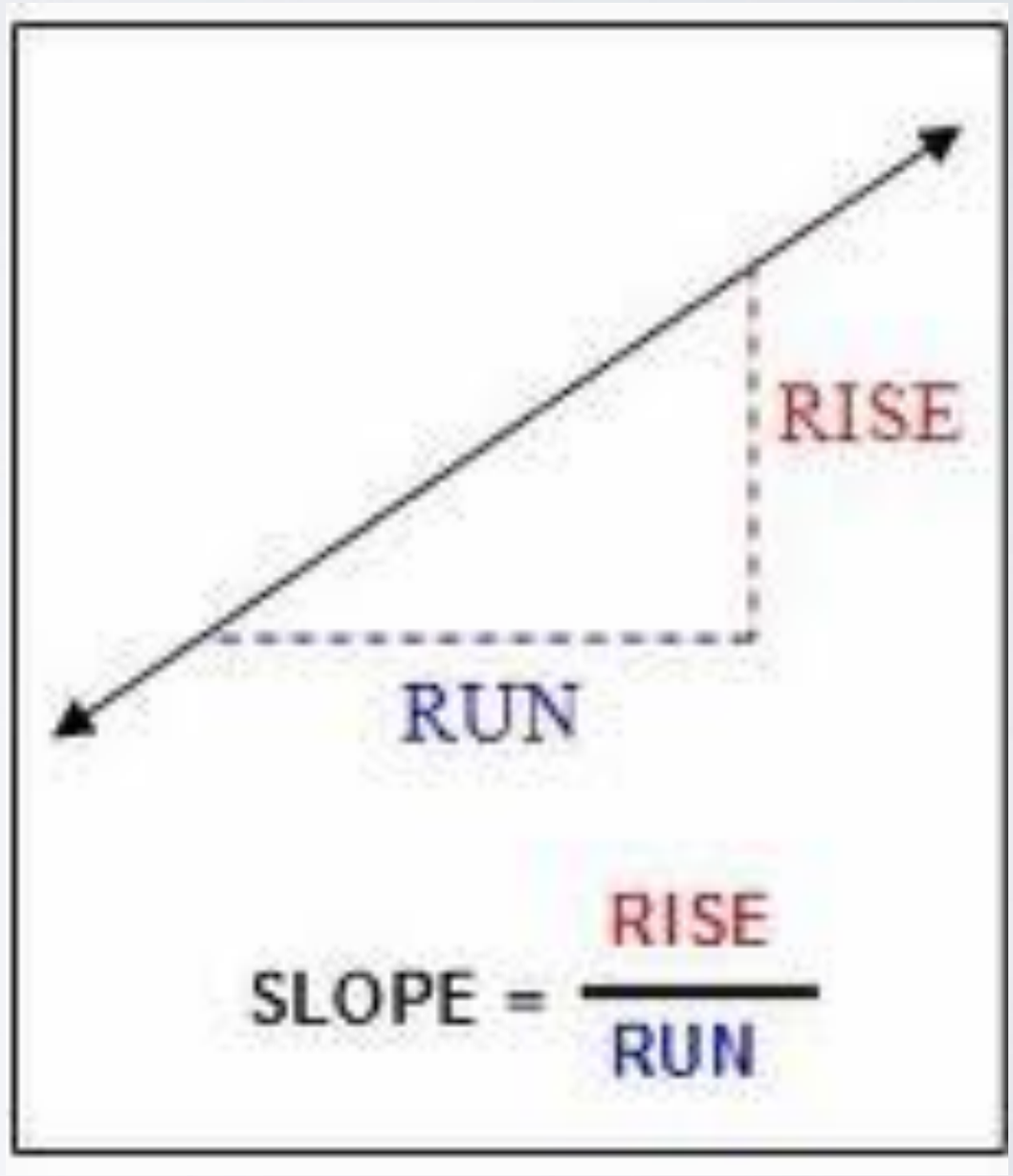
The steepness of the line's slope depends on the speed of the object. A constant slope represents motion at constant speed.

You can show the motion of an object on a line graph in which you plot distance versus time. A straight line represents motion at a constant speed. A point on the line represents the distance an object has traveled at a particular time.

The steepness of the line is called slope. The slope tells you how fast one variable changes in relations to the other variable in the graph. In other words, slope tells you the rate of change.

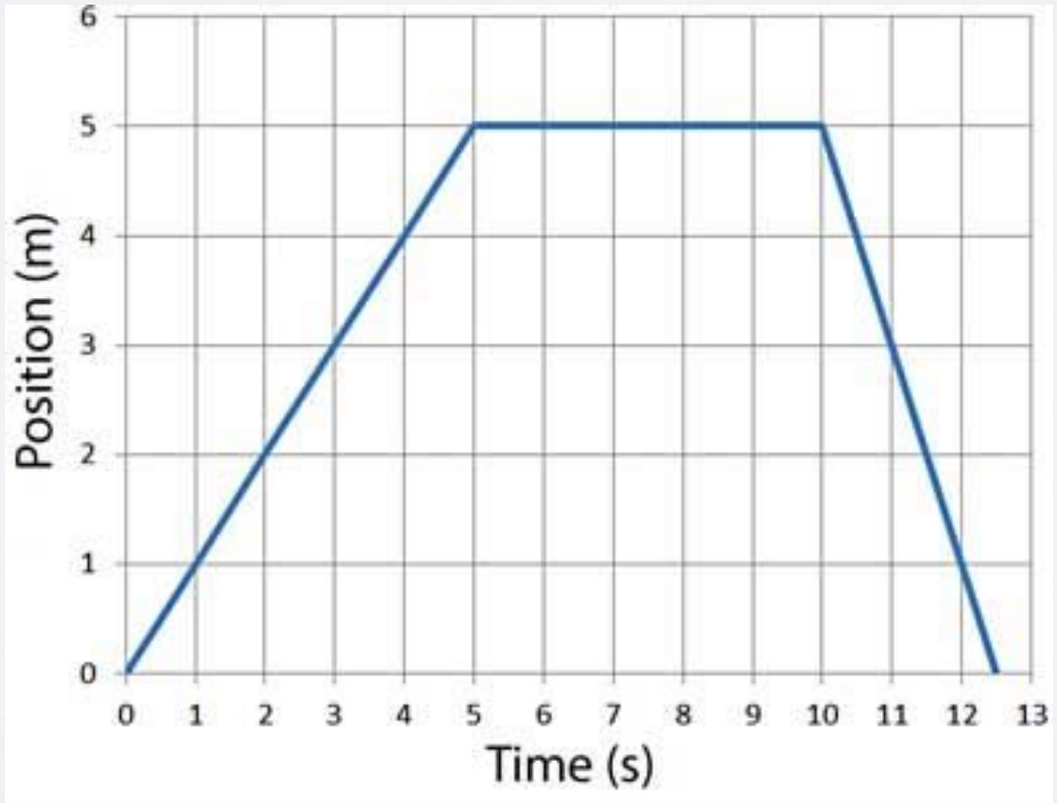
CALCULATING SLOPE

You can calculate the slope of a line by dividing the rise by the run. The rise is the vertical difference between any two points on the line. The run is the horizontal difference between the same two points.



DIFFERENT SLOPES

Most moving objects do not travel at a constant speed. A horizontal line represents an object that is not moving at all.



KEYWORDS: ENGLISH - SPANISH

Instantaneous Speed - Velocidad Instantanea

Motion - Movimiento

Reference Point - Punto de Referencia

Units - Unidad

Meter - Metro

Rate - Tarifa

Slope - Cuesta Abajo

Speed - Velocidad

Velocity - Velocidad